The invention claimed is:

1. A system for tracking and regulating an optical beam, comprising:

a) at least one solid-state optical beam regulator;

b) an optical sensing device;

c) a computer for calculating control signals using beam information from the optical sensing device.

2. The system of claim **1** wherein at least one beam regulator operates by refraction.

3. The system of claim **1** wherein at least one beam regulator is a stress-optic refractor.

4. The system of claim **1** wherein at least one beam regulator is capable of two-dimensional steering.

5. The system of claim **1** wherein the optical sensing device uses a portion of the transmitted beam reflected from the target as the beacon for tracking, steering and shaping the transmit beam.

6. The system of claim **1** wherein at least one beam regulator acts as a lens to re-focus the beam or return the beam to a collimated state.

7. The system of claim **1** wherein the system includes two one-dimensional stress-optic refractors in series.

8. The system of claim **1** wherein the optical sensing device is a CMOS imaging device.

9. The system of claim **1** wherein the optical sensing device senses a region of interest that is less than the total frame area, so as to perform at a faster frame rate, thereby allowing the device to respond to faster beam movements.

10. The system of claim **1** wherein the optical sensing device provides beam position and shape information to the computer and thence to the regulator at speeds greater than 1 kHz and position accuracies better than 1 microradian.

11. The system of claim **1** wherein the computer receives information about the beam's position from the optical sensing device, calculates the beam's displacement from a reference position, and then sends steering signals to the beam regulator, so as to steer the beam toward the reference position.

12. The system of claim **1** wherein the computer receives information about the beam's size and shape from the optical sensing device, calculates the beam's deviation from desired collimation, and then sends shaping signals to the beam regulator, so as to shape the beam toward the desired collimation.

13. The system of claim **1** wherein the system steers the beam in two dimensions and at microradian accuracy.

14. The system of claim **1** wherein at least one beam regulator can function at frequencies greater than 1 kHz.

15. A system for tracking an optical beam and regulating an optical beam over a range of frequencies including frequencies greater than 1 kHz, comprising:

a) at least one optical beam regulator;

b) an optical sensing device; and

c) a computer for calculating steering and/or shaping signals using beam information from the optical sensing device.

16. The system of claim **15** wherein at least one beam regulator operates by refraction.

17. The system of claim **15** wherein at least one beam regulator is a stress-optic refractor.

18. The system of claim **15** wherein at least one beam regulator is capable of two-dimensional steering.

19. The system of claim **15** wherein at least one beam regulator acts as a lens to re-focus the beam or return the beam to a collimated state.

20. The system of claim **15** wherein the system includes two one-dimensional stress-optic refractors in series.

21. The system of claim **15** wherein the optical sensing device is a CMOS imaging device.

22. The system of claim **15** wherein the optical sensing device senses a region of interest that is less than the total frame area, so as to perform at a faster frame rate, thereby allowing the device to respond to faster beam movements.

23. The system of claim **15** wherein the optical sensing device provides beam position and shape information to the computer and thence to the regulator at speeds greater than 1 kHz and position accuracies better than 1 microradian.

24. The system of claim **15** wherein the computer receives information about the beam's position from the optical sensing device, calculates the beam's displacement from a reference position, and then sends steering signals to the beam regulator, so as to steer the beam toward the reference position.

25. The system of claim **15** wherein the computer receives information about the beam's size and shape from the optical sensing device, calculates the beam's deviation from desired collimation, and then sends shaping signals to the beam regulator, so as to shape the beam toward the desired collimation.

26. The system of claim **15** wherein the system steers the beam in two dimensions and at microradian accuracy so as to point the beam continuously at a distant receiver.

27. A method of optically communicating in free space for metropolitan access to optical fiber networks, comprising the steps of:

a) providing the system of claim **1**; and

b) operating the system to track and regulate at

least one optical beam to provide duplex optical communications between sites separated by 200 to 1000 meters.

28. A method of optically communicating in free space, comprising the steps of:

a) providing the system of claim **1**; and

b) operating the system to track and regulate at least one optical beam to provide communications between two sites, at least one of which is mobile.

29. A method of optically communicating in free space, comprising the steps of:

a) providing the system of claim **1**; and

b) operating the system to track and regulate at least one optical beam to provide communications between an earth-orbiting satellite and a ground station or between two earth-orbiting satellites.

30. A method of optically communicating in free space, comprising the steps of:

a) providing the system of claim **1**; and

b) operating the system to track and regulate at least one optical beam to provide communications between satellites in deep space wherein the reference beam may be a beacon from earth or a known planet or star.